FLIGHT SYSTEM SURVEY

Trident Autoflare Equipment

THE equipment and operating sequence of the autoflare system initially to be put into service in the de Havilland Trident are described in an article by J. W. Wilson, one of the company's operations engineers, in the *de Havilland Gazette* this month. Present autopilot-coupled approaches cannot be continued much below 200ft, partly because of the run-away characteristics of single-channel autopilots and partly because the normal ILS glide-slope signals become unacceptable below about 150ft. The automatic flare-out landing is made following a normal ILS-coupled approach with automatic throttle control. At about 150ft on a 2½ to 3° glide-slope, the aircraft is approximately 3,000ft from the glide-slope transmitter and, therefore, some distance short of the runway or its level undershoot area. Glide-slope guidance must be disconnected, but radio altimeter height-guidance cannot yet be relied upon, because undulating ground or obstructions might interfere with height measurement.

The aircraft would be over suitable ground at about 70ft; and the hiatus between glide-slope and altimeter guidance, lasting a few seconds, would be covered by holding a pitch attitude averaged during the preceding approach phase. This sequence is clearly shown in the diagram reproduced below. Below 70ft pitch attitude is controlled by the autopilot, using height and rate-of-change of height signals derived from the radio altimeters, and power is automatically reduced during the flare-out. It remains for the pilot to control yaw and roll, and he must be able to see sufficiently well to line-up the aircraft with the runway and to kick-off drift. The operations he has to perform are shown in the diagram and table. As well as controlling yaw and roll, he must monitor the automatics to see that they are operating correctly, and must be ready to take over in the event of a failure.

Mr Wilson points out that the successful exploitation of automatic flare-out may in reality depend on the confidence of the crew in the equipment, and upon their ability to monitor the automatics effectively. No very great reduction in weather minima is expected, because the pilot must still be able to see the runway.

The Trident equipped for automatic flare-out will not initially have the full triplex Smiths SEP.5 autopilot intended for automatic landing, although the remaining equipment can easily be added at a later date to up-grade the system. Neither does all the equipment have to have the same level of multiplexing as that part which is actually involved in the final automatic sequence. Whereas a triplex channel will, following a failure of one channel, continue to operate automatically undisturbed, a duplex channel will simply disengage altogether, leaving the aircraft in a trimmed condition ready for the pilot to take over.

The initial scale of equipment for the Trident will comprise a duplex autopilot; duplex yaw-damper and single Mach stabilizer; duplicate compass system; triplicate attitude-reference system (three Sperry VG.102 vertical gyros); duplicate air data system; single flight director system; single Smiths Para-Visual Director system; duplex Smiths automatic throttle control system; and a triplex Standard Telephones radio altimeter installation.

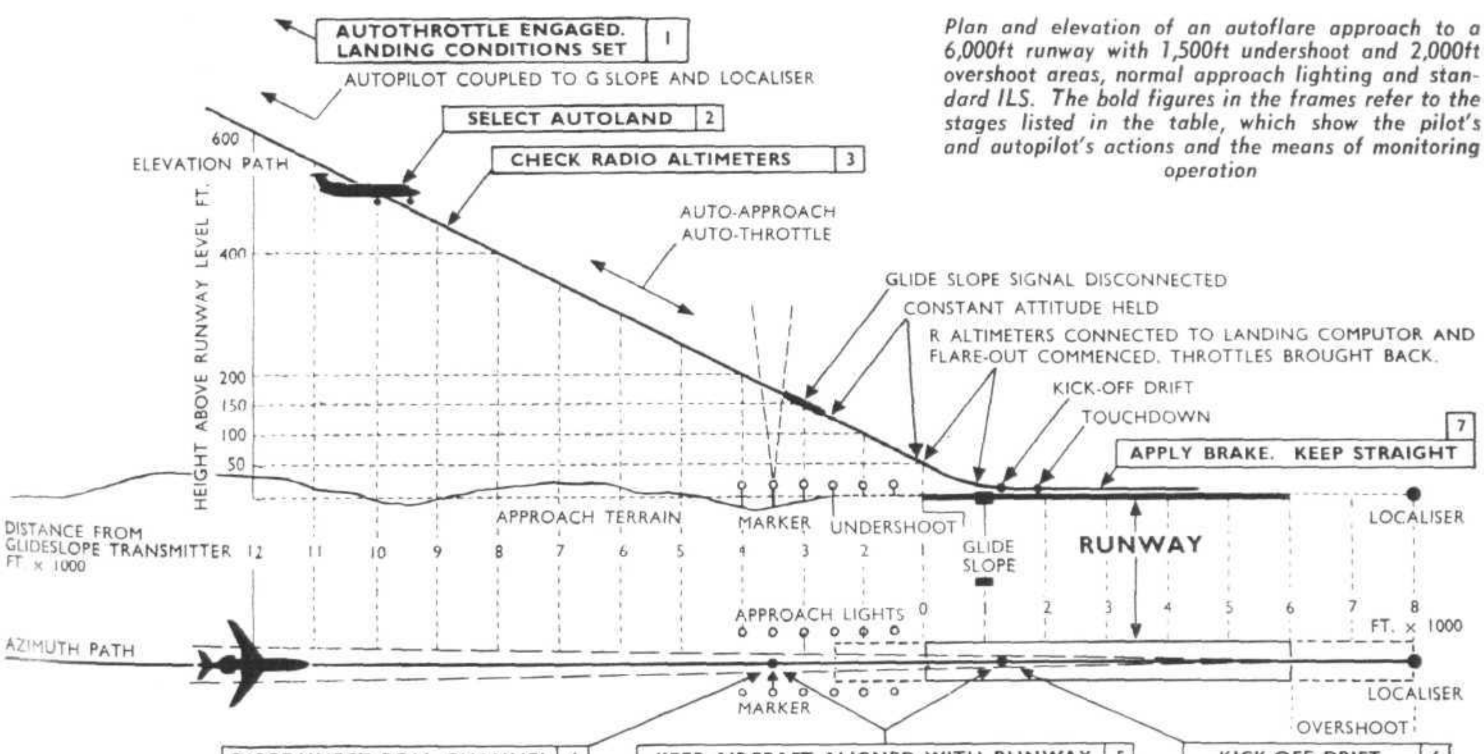
Should the duplex autopilot disengage, the pilot should be able to complete the landing visually, but he will be assisted by the PVD indicators, which will be immediately uncovered and are operated by a separate computer. Altimeter signals would not be lost, because of the triplex installation. There is therefore a degree of second stand-by. If the pilot for some reason decides to overshoot, he has simply to open up the throttles to full power. It is significant that de Havilland state that it is possible to re-engage the "good" half of a duplex channel after a failure "provided that the aircraft is adequately safeguarded by other means against a run-away fault of the single channel." This appears to imply some form of monitoring for each sub-system in a multiplex channel as well as cross-checking inherent in multiplexing.

The acceptance by the pilots of the Trident automatic flare-out system is going to be a determining factor in the timing and rate of introduction of full automation.

Ref	Pilot Function	Autopilot Function	Means of Monitoring Automatic Control
1	Engage "Autothrottle," engage "Glide," set in landing conditions	Hold approach air-speed, hold glide-slope and localizer beams	Reference to a.s.i., throttles moving. Reference to flight compass and visual information
2	Select "Land"	Hold glide-slope and localizer beams	Reference to flight compass
3	Check radio altimeters	—	Radio height indicators
4	Disconnect roll channel	Glide-slope signal disconnected. Constant attitude held. Radio altimeters connected to landing computer	Reference to attitude director and flight compass, checked by visual information
5	Keep aircraft aligned with runway	Flare-out started	Reference to visual information and Para-Visual display
6	Kick-off drift	—	—
7	Apply brake, keep straight	Throttles to idle, touchdown completed	Throttle position, r.p.m., visual information

Gyropilot for the Piaggio P.166

FOLLOWING recent successful trials in a Piaggio P.166 now delivered to the Consolidated Zinc Corporation of Australia, the Sperry AL.30 Gyropilot has been certificated for operation in this type of aircraft. Another AL.30 is to be fitted in the United Steel P.166 and the equipment is to be an accepted optional extra. The AL.30 has also been specified by the Italian Air Force for the military P.166, a substantial number of which are likely to be ordered.



Plan and elevation of an autoflare approach to a 6,000ft runway with 1,500ft undershoot and 2,000ft overshoot areas, normal approach lighting and standard ILS. The bold figures in the frames refer to the stages listed in the table, which show the pilot's and autopilot's actions and the means of monitoring operation